Converting to 300 mm

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Abstract – Single large companies have led past wafer size conversions. These companies incurred significant conversion costs while paving the way for everyone else. This conversion is different and this presentation will explain why and summarize the key conversion drivers. Additionally key issues and sensitivities concerning the change will be discussed.

INTRODUCTION

Single large companies (150 mm Intel/200 mm IBM) have led past wafer size conversions. These companies incurred significant conversion costs while paving the way for everyone else. This conversion is different. Tool suppliers have invested heavily to develop 300 mm tools. Early in the 300 mm equipment product development cycle, rigorous industry expectations were defined for tool performance, reliability, cost, utility consumption, installation design, environmental impacts, footprints, etc…. Industry standards (SEMI) and guidelines (I300I) were set for tool interfaces, wafer handling, buffering, automation, and safety. The efforts of several consortia contributed to the data collection efforts on many tool types. Additionally, many of the next generation tools are being developed on 300 mm platforms.

Intel's conversion to 300 mm is driven by cost but other companies could be driven by capacity. Intel believes that conversion timing is right but it is not without risk with regard to tool cost and performance. Some of the key benefits of a 300 mm conversion are lower cost product, productivity improvement and reduced resource consumption.

COST

There are some significant ratios that merit careful consideration. First, the key driver, is the ratio of die per 300 mm wafer as compared to 200 mm. A 300 mm wafer can yield from 2.25X, for small die, to 2.5X- that of a 200 mm wafer on larger die. This is a gross cost reduction opportunity of 56-60%, before taking any cost increases into account. In order to capitalize on this opportunity the capital cost/output and output/unit of space, for each tool, must be optimized. Additionally, the consumption of material and resources, in total, cannot scale with the wafer size. Otherwise it degrades the cost reduction opportunity. The second ratio of significance is that the output of a 300 mm factory is 1.6-2.2X that of a 200 mm factory producing the same product. The output scalar represents good progress on the tool performance and footprint front, for the non-die-based tools. This was an area that did not get stressed as much during the 200 mm conversion.

The output ratio also reduces the impact of the facility cost on product. A 300 mm factory will cost close to the same as a 200 mm factory but the product output is higher.

The 200 mm factory costs increased significantly over the 150 mm generation and factory output only increased by a factor of ~1.2X. The die and output scalars are the key drivers that yield an opportunity to achieve a 30% cost reduction on product made with 300 mm wafers.

The cost categories that get prime attention are equipment, silicon, and support material in the form of spare parts, chemicals and gases. Equipment cost is by far the largest factor, and is aggravated by die based tools in lithography and metrology. Equipment cost targets, consistent with the 30% cost reduction goal, must be met in order to achieve the full cost reduction and is a focus of current work where more progress is still needed. Silicon cost is not at parity with 200 mm and will need to improve even more than it has already. Support materials, spares, chemicals and gases, will need to be watched carefully to ensure that cost and consumption are in line with the cost reduction goal of 30%.

PRODUCTIVITY

Tool performance and footprint are key parameters in the measurement of productivity. Good progress has been made in the non-die based tool performance testing and footprint designs, which has counteracted some of the negative impacts from the die-based tools. We expect the actual tool performance to be better than our base assumptions used for planning. The fact that upfront expectations were set, with suppliers, and were based on good industry consensus around tool performance, cost, and footprints is a key factor in enabling the program to move forward. Additionally the standards that were adopted have enabled the industry to focus on common automation interfaces and will enable the 300 mm generation to have the first fully automated factories. More work is needed on the die-based tools, especially lithography, and has a large impact on capital cost. Actual tool selections are proceeding through our standard selection process with the expectation that the tools will be manufacturing capable. As stated earlier the output scalar, of 1.6-2.2X for a 300 mm factory compared to a 200 mm factory, represents good progress in controlling tool footprints and taking advantage of the new automation capability. The actual performance of tools still needs to be demonstrated in a full manufacturing environment.

REDUCED RESOURCE IMPACT

With a 300 mm conversion fewer factories will be required to produce the equivalent output of a 200 mm factory. One of the hidden benefits of the conversion is that the 300 mm factory collective will use fewer of a variety of resources including utilities, and people.

While utilities for a 300 mm factory will be greater than an equivalent sized 200 mm factory they will not scale with the wafer size and should use close to 40% less when normalized to the product produced (this will vary depending on the actual utility). This factor has implications in reducing the impact on our natural resources in addition to a lower impact on the environment. Recruiting and training the people to run and operate the fabrication plants is a huge task. Fewer factories mean fewer people to process the same amount of product. Additionally, a 300 mm factory may not require as many people to operate as an equivalent sized 200 mm factory considering the reduced number of tools and the higher levels of automation.

SUMMARY

Much work still needs to be completed before we see success in 300 mm. The industry will need to continue to maintain the excellent progress in standards, in addition to keeping up the pressure to improve on equipment performance, cost control, and reductions in material and utility consumption. To reiterate again, the key benefits of a successful 300 mm conversion lay in lower cost product, improved productivity and reduced resource consumption.

The advance groundwork cultivated over the last several years' gives us the opportunity to make this the most successful conversion ever.

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